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XVI. *A Letter from Mr. Anthouy van Leeuwenhoek, F. R. S. containing some further Microscopical Observations on the Animalcula found upon Duckweed, &c.*

Delft, June 28. 1713.

IN my Letter of the 4th of *November*, 1704. I took Notice of the wonderful Figure of an *Animalculum*, that was fix'd in a little Scabboard or Sheath, fasten'd to some of the small green Weeds that are found in Ditches full of Water. It is described in the said Letter by Fig. 1. [See *Philosoph. Transact.* No. 295.]

As often as I have view'd these *Animalcula*, and communicated the Sight of 'em to others, we could not satisfy ourselves with looking upon such wonderful Creatures; and the more, because we could not conceive how so surprizing a Motion, as all of 'em had, could be perform'd; as also what should be the use of such a Motion. For when we observe other Creatures, that are endued with Motion, moving any Parts of their Body, we presently conclude, that the Parts which they move, are not created in vain; and consequently we may assert, that the wheel-like Motion of the above-mentioned *Animalcula*, is useful to their Bodies, tho' we cannot tell exactly how.

In the latter end of *July*, and in the beginning of *August* last, I caus'd some of those green Weeds, which they commonly call Duck-Weed, to be taken out of the Water, that runs with a gentle Stream thro' the Town,
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and before my House, only for the Pleasure of observing the afore-mention'd *Animalcula* ; together with others of several sorts, that were fastn'd to the said Duck-Weed, or ran about upon it.

Among others, I have found some *Animalcula*, the Sheaths of which, at the extream Part, were a little thicker than a Hair of ones Head ; which Sheath was compos'd of small Globules, that were very easy to be distinguish'd.

I view'd one of these *Animalcula* for a good while together, till I was almost weary, and observ'd several times one after another, that when the *Animalculum* thrusts its Body out of the Sheath, or Case, and that the Wheel-like or indented Particles mov'd in a Circle, at the same time, out of a clear and transparent Place, a little round Particle appear'd, which, without nice viewing, could hardly be perceiv'd ; which Particle growing bigger, mov'd with great swiftness, as it were, about its own Axis, and continued without any alteration in its place, till the *Animalculum* had drawn part of its Body back into its Sheath ; in doing which it plac'd the said round Particle upon the Edge of its Sheath, which became thus augmented with a round Globule : And whereas the *Animalculum* had plac'd the said Globule upon the East part of its Sheath, another time it fixt it upon the South or North side ; by which means the Sheath was regularly encryst'd on all sides. From whence it plainly appears, how^e much the Wisdom of God is concern'd in the regular Formation of the said *Animalcula*.

Having further, and with great exactness, view'd the circulating indented Wheel-work, I observed that it caus'd an unconceivable great Motion in the Water round about it ; by which means abundance of exceeding small Particles, which were only visible through the Microscope, were wafted to the said *Animalculum*, and
Y others

others were driven away. The *Animalculum* made use of some of these Particles, that were thus drawn to it by its circulating Instrument, for Food and Nourishment; and other Particles being almost come to it, were with great Nimbleness driven away; and, as it were, rejected by the *Animalculum*: From whence I infer'd, that those Particles which were thus thrust away, were not proper for its Food.

From this Discovery we may conclude, that since this kind of *Animalculum* cannot move from place to place in the Water, nor consequently seek its Food as other Creatures do, (that are endued with Motion) being fasten'd by the Tail or other Parts of the Body, it must necessarily be provided with such Instruments as are fit to move the Water, and by that means come at the Particles floating in it, which serve for the Nourishment, increase and defence of its Body.

If we observe those *Animalcula*, which, with their long Tails, are fasten'd to some part or other of the Weed, as we have discovered a great many on the little Roots of the Duck-Weed; we may observe, that they do not only make a Circular Motion with the extream part of their Bodies, which Motion, in proportion to the said part, is very great; but they can likewise draw in their Tail, and that with a very quick Motion; by which means they can move the Water out of its place, when they stretch their Tails out again, and so bringing fresh Water under them, they procure new Food.

I likewise observ'd a very few *Animalcula*, whose Bodies were short and thick, and which were much bigger than those other *Animalcula* that hous'd themselves in a Sheath, and were fasten'd by their Tail, or extream Parts, to the little Roots of the Duck-Weed: And altho' these short and thick *Animalcula* could move from place to place, yet they also had a Circular Motion in the fore part of their Bodies. From whence I concluded,
that

that those Motions serv'd some other purposes than only to draw their Food to 'em.

I have formerly reflected, what could be the use of these indented Wheel-works, which are so like the indented Wheels of a Clock, or Watch; but when I consider further of the Matter, I must own that they are very necessary to produce a great Motion in the Water; for if it were a round and a smooth Wheel, such a one wou'd cause but a very small Motion; whereas now each Tooth in the said Wheel or Circle produces a great Motion, in comparison of what a smooth and plain Wheel wou'd do. From whence appears the mysterious and unconceivable Order in the formation of such small Creatures, which are not to be perceiv'd by the naked Eye.

In the beginning of *August* I was in a Garden that had a Pond full of Fish, upon the Water of which I observ'd a thin Scum floating that was of a greenish Colour, tho' there was nothing Green in the Water; which seem'd strange to me, because at other times I had observ'd that the Water of the said Fish-Pond was very clear, and so was that which fed it; and they told me moreover, that when it rain'd the said Scum disappear'd.

I took then a little piece of a Wooden Lath, and drawing it over the Superficies of the Water, I plac'd a small Drop of the Water upon a Green Wine Glass, and then view'd the same with the Microscope, and discover'd an inexpressible Number of *Animalcula*, so exceeding small, that they almost escap'd my sight thro' the Microscope; insomuch, that no Body wou'd scarce believe it but those that have seen it; There were also several sorts of bigger *Animalcula*, mixt with a great Number of little Air Bubbles of an exceeding smallness. A few Days after I desir'd 'em to bring me a little of the same Water, that I might examine it more nicely;

but I could make no further Discoveries than what I before mentioned ; and I observ'd soon after that there were no Air Bubbles remaining.

Now when People wash their Beer and Wine Glasses in such a Pond, who can tell how many of those *Animalcula* may remain sticking upon the sides of 'em, and by that means come into the Mouth ; which being so, People have no reason to ask me, how the little *Animalcula*, which I observed some Years ago in the Matter that remains in and about our Teeth, came thither.

Thus far my Observations, which I had made some Years ago, and which within these few Days are fallen again into my Hands.

I can't forbear acquainting you, that I have lately observ'd in the Flesh of a Whale (and the same is to be said of an Ox, and even so low as a Mouse,) that the Fibres thereof, altho' sixteen times smaller than a thick Hair of my Beard, yet are surrounded or involved in little Membranes, in such manner, that the fleshy Particles do not touch each other.

I am, &c.

Anthony van Leeuwenhoek.